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REMOTELY PILOTED VEHICLES -- NECESSITY, WISHFUL THINKING OR PLAYTHING

R. Olsen

Translation of "Unbemannte Flugkörper - Notwendigkeit, Wunschdenken oder Spielerei," Flug Revue/Flugwelt International, Dec. 1973, pp. 27-30, 35-38

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16. Abstract

A survey is made of the various classes of unmanned flying craft and their applications, and their history is outlined, covering balloons, drones, early missiles, guided missiles, the German space program prior to and during WW II, and VTOL equipment. The most important military uses for RPVs are concluded to be reconnaissance and transport, the latter also possessing spinoff value for the civilian sector. Fighter RPVs are found to be ineffectual, whereas the one-way delivery of weapons has proven quite feasible.

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REMOTELY PILOTED VEHICLES -- NECESSITY, WISHFUL THINKING OR PLAYTHING

Richard Olsen

Is the development, testing and production of unmanned flying craft[1] /27*

-- a military/tactical necessity,

-- wishful thinking on the part of an industry that is not occupied at full capacity,

-- a plaything for development engineers, or

-- a combination of several of the assumptions made above?

is the way a quiz question might be worded whose answer would at the same time have to justify the expenditure of millions of German marks. The wave of interest in RPVs (= remotely piloted vehicles) from the US is rolling toward Europe in technical literature and in industry, i.e. the idea that war in the future will largely be fought from the air with unmanned, indirectly guided flying craft of all types and that it is time to rethink, replan, to finally approve funds for R&D and not to block progress.

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[1] [Translator's note: The author refers to RPVs as "unmanned missiles;" since the German word for "missile" is compounded from the words for "flight" and "body," however, he also applies this term to such things as balloons and kites. "Unmanned flying craft" will generally be used for the sake of comprehensiveness (unless the author actually uses "RPV").]

* Numbers in the margin indicate pagination in the foreign text.

The impression is obtained here that published reports on the superiority of RVPs over manned aircraft are just as much a fact as the possibility of being able to fully utilize industrial capacity for years through the mass production of inexpensive and efficient products. On the basis of trials performed by the USAF, revolutionary conclusions are being drawn which once more come very close to the idea of "push-button warfare" in the future, as happened when flying craft reached the production stage. Even the Europeans believed this, until they saw the realities involved. It is therefore worthwhile to cover those aspects connected with the problem of unmanned flying craft in greater detail, since it is supposed to be a factor in determining

-- the military security of the West vis-a-vis the East,

-- the mass production of less expensive products in the aircraft industry for the armed forces,

-- a change in military tactics and strategy.

In order to be able to make an evaluation, we require both insight into detailed problems and a survey of the entire RPV complex -- otherwise, any judgment remains piecemeal.

What are Unmanned Flying Craft?

This question must first be answered clearly. It indicates the scope of the problem. The idea that RPVs are just oversized hobbyist's free-flight models or smaller versions of aircraft which were previously manned is wrong, since these include only a fraction of the unmanned craft which fly or orbit above the Earth's surface in the air or in space close to the Earth. If we wish to obtain a survey of the state of the art, it can only involve the systematic coverage of all flying craft which are already being used or will be used in the air or in space. We find here that the definition of the word "flying" involving motion through the air, only, with the aid of aerodynamic lift is no longer sufficient, since thrusts which exceed the Earth's gravitational attraction for mass propel a body into space from the center of the Earth. Does it now fly, or only as long as it moves within the Earth's range of attraction or in its layer of air? We still apply the term "flying" to this motion, even though it no longer has anything to do with the flight of fixed-wing aircraft. Thus everything becomes confusing. Nevertheless, the survey permits us to list the similarities and differences exhibited by flying craft.

They all have the following in common:

-- an airframe

-- a means of lift or propulsion

-- a method for determining location above the Earth's surface

-- a control method for maintaining attitude in space.

Here again a semantic problem arises, between the terms "guidance" and "control." Do we guide an aircraft or rocket, or are these controlled? Do we thus apply control? Does "control" refer more to a mechanism, and "guidance" to a method? In this survey, guidance has been related to the determination of location, while control has been applied to attitude control and the mechanical aspect.

The differences now arise because of variations in those areas which are common to all. Since the different features can be combined in various ways, the result of their consideration is a large number of unmanned flying craft which correspond to technical reality. The survey breakdown of unmanned flying craft thus exhibits the large number of technical possibilities, which fall into categories on the basis of their (air)frames:

A. Balloons
B. Aircraft (unmanned, drone)
C. Missiles (unmanned, recently developed)
D. Rockets (airframes developed without aerodynamic lift)
E. VTOL platforms (unmanned vertical-takeoff flying craft)
F. Kites (cord-held flying craft).

Kites have been mentioned for the sake of completeness. They originated in China thousands of years ago. Their military application was brief; they were used in the form of box kites in winds that were too strong for captive balloons. After that, they were used by children as toys, as they are today. Airships have not been included; they have never been used unmanned in the military sector, but only manned, and therefore do not come under this survey.

Once we have become familiar with this survey of technical possibilities, it becomes profitable to compare them with the types of missions which can be considered for these unmanned flying craft in the military sector, which is of interest here.

Military Missions

This survey gives a total of four different types of missions into which combat activities can be divided:

A. Reconnaissance missions
B. Combat missions
D. Transport missions
D. Training missions.

These categories of missions are performed by those branches of the armed forces which are specifically equipped and trained for conducting warfare

-- on land

-- in the water

-- in the air.

Any country that wishes to defend itself in case of attack faces these realities and must break its armed forces down into an army, navy and air force, which are equipped with vehicles, ships and aircraft as the means of transporting their weapons (carrying platforms for armament systems) and have been trained in their application.

This summary shows what missions from the air occur within the military sector and by which branch of the armed forces they must be carried out. It can clearly be seen here that the air can no longer be the responsibility of one branch, the air force, alone, since the ranges of missions specific to the army and navy could no longer be looked after by a branch trained only for aerial warfare. The problem here is not just time wasted for communications from one to the other, but special missions that require special equipment and training. This list can be expanded indefinitely. The outline would not thereby be changed, but only further subdivided. In order to keep to an overview, we have stayed within the limits indicated.

If we now compare the survey of unmanned flight craft with the miliary missions, we find that the sector which would also make possible the use of the products of industry in the civilian area /28
cannot yet be considered for RPVs at this time: the transportation sector. In spite of the much-lauded perfection of the engineering, its reliability and its precision, no one would dare to sit in robot aircraft without pilots in order to fly from point A to point B. Man, as an independently acting and thing being, remains the ultimate safety factor in air travel.

We thus obtain

-- a forward-looking goal and

-- the present limits

for the technical development of unmanned flying craft. For as long as there is no civilian function for products of an industry, this production will never be worthwhile, but will be inflationary, since it is not to be purchased on the open market by the ordinary consumer. The production of items not required in civilian existence contradicts the principles of the open market, since something is produced for which no natural need exists. Production does not match the need of the ordinary consumer. An item is not a true equivalent for money where military materiel is involved that cannot be bought on the so-called open market but is planned by the state, and thus upsets the entire financial planning of countries that do not consider themselves to have planned economies. For this reason, the large-scale production of RPVs is already restricted in terms of the national economy. It would not secure jobs, by and large, but rather make them insecure. The money spent for the large-scale production of RPVs possesses no equivalent on the open market, but only in the state-planned economy. This would only change if a real goal for civilian use were to occur, i.e. a natural demand on the part of individuals could be satisfied. Why, for example, should the remotely guided transport of materiel not be cheaper without pilots? Or why should it not be possible to improve instrument-landing equipment and procedures with RPVs?

Aside from the recognizable limitations, in terms of the national economy, on previously predicted large-scale RPV production to relieve the man at the control stick, limits of sensibility exist in the military sector wherever usefulness is questionable. In order to make these limits of usefulness recognizable in the miliary sector, we base our considerations on realities for the sake of safety, i.e. on the present-day development of unmanned flying craft and the different ways in which they can be used:

- -- surface-to-surface
- -- air-to-surface
- -- surface-to-air

plus the special areas of space travel and vertical takeoff. A number of survey tables make it easier to take in all of this material. The first two surveys of RPVs and military missions provide aid in orientation here.

Use of Unmanned Flying Craft for Military Missions

A. Balloons

Nowadays when a balloon floats above the ground noiselessly with the air currents, hardly anyone thinks about the inventor of balloon flight, Montgolfier, a genial Frenchman. He observed that hot air rises and utilized this effect by allowing lighter (= hot) air to rise into a vessel of low weight that was air-tight. The difference in the specific gravities of the air was sufficient to support the envelope of the balloon and, later, additional ballast. Man could "fly" with the aid of the balloon.

Moving skyward means obtaining a wider view of the Earth's surface or having an opportunity to overcome obstacles on the ground. There was also the possibility of transportation and of research. The fact that one could see farther was made use of by the military, for whom observation of the enemy was a decisive factor in warfare. Only an elevated viewpoint was required, not free flight, and the balloon was put on a captivating cable. The captivating cable became a barrage cable that cut up the surfaces of aircraft that flew against it. The advantages of balloons were their

-- payload capacity
-- altitude above ground as a plane of observation
-- time for observation.

The disadvantages were the large volume of the balloon envelopes (making them detectable), their immobility, and the hazard of fire. As late as 1943, the Russians used them on the Eastern Front as observation balloons, while balloon barrages were used in England to protect objectives on the ground against low-level attack. Balloon barrages with special cables could even be important today as protection against low-flying aircraft. But they can no longer be found anywhere in the equipment of armed forces. They would force low-flying aircraft to climb and thereby enter the hazardous region presented by ground-based antiaircraft weapons.

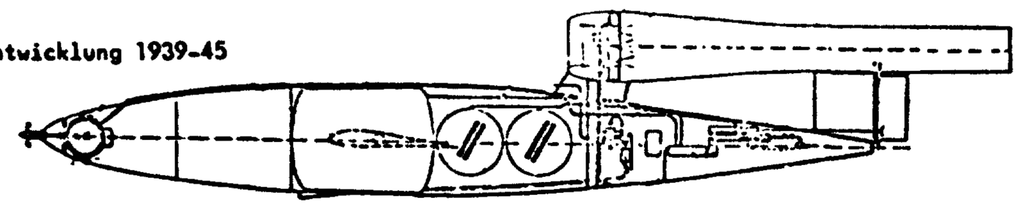
B. Aircraft, Unmanned and Operated as Drones

"Drone aircraft" refers to the secondary utilization of manned aircraft for unmanned flight. In technical terms, the pilot is replaced here with stabilization platforms, computers and remote-guidance instruments operated from the ground. The aircraft is remotely started, taxis for a takeoff, takes off on a runway, lifts off and is operated from the ground, via switches and levers, in such a manner that the difference in flight behavior would not be obvious to an observer who could not look into the cockpit.

The usefulness of such engineering developments must be measured, in the military sector, in terms of the outlay required. /30
Since these are aircraft originally designed to be controlled by pilots, the required outlay is increased by conversion. The pilot is not replaced but moved -- behind a console somewhere on the ground. The technical equipment necessary for data transmission is expensive, but still jammable. The use of manned aircraft in the military sector remains, and will remain, more effective than the

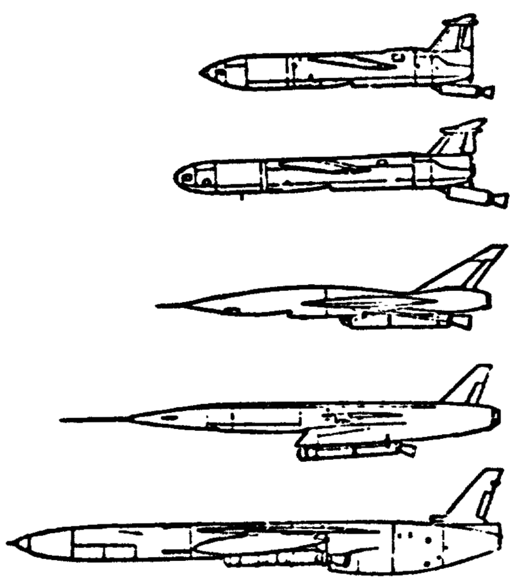
V - 1 (Fieseler FI-1o3)

d
Deutsche Entwicklung 1939-45



a) 32o km
b) o.5 - 3 km
c) 5-8oo km/h

e
USA-Entwicklung nach 1945



	a)Reichweite km	b)Flughöhe km	c) Geschwindigkeit km/h
Matador TM-61C	1 ooo	14	9oo
Mace TM-76	1 1oo	12	1 ooo
Goose SM-73	1 5oo	13	1 8oo
Regulus II	1 6oo	15	2 2oo
SNARK SM-62	5-1o ooo	23	1 ooo

Surface-to-surface flying craft with bursting charges (offensive).

Key: a. Range; b. Altitude; c. Speed; d. German development;
e. US development after 1945

operation of combat aircraft as drones, since their use in transportation and training cannot be considered anyway. Only the use of test carriers for electronic instruments, for systems and procedures is reasonable, but the pilot still flies with them for reasons of safety and economy so that he can intervene if there is a technical failure. No demand exists beyond the use of single aircraft. But all experience which engineering has so far accumulated with manned aircraft is being applied here to designs which are sketched out, developed and built as unmanned aircraft from the outset. Hardly a development occurs in the sector of manned aviation which does not exhibit a counterpart among the RPVs.

Development to this end began on the German side during World War II, on all types of applications coming under consideration here. These technical developments during the period prior to 1945 remained unknown to many. During the War, secrecy was a burden on those doing the work. After the War, people spoke of "wonder weapons" that were being developed. These were no w... rs that were developed then. They were technical developments ...t were based on information and products which had been acquired much earlier and then forgotten and which received almost unlimited state support because of demands during the War. The engineers were permitted to implement their ideas free of material and administrative restrictions. The results of this developmental freedom are surprising, since the products derived later took men not only to the Moon but also to the development of unmanned flying craft which are presently beginning to make headlines.

The Battle of Britain, fought in the air, sapped the Luftwaffe. Although industry moved underground and achieved a rise in production in spite of bomb raids and the destruction of above-ground factories, it was not possible to train the necessary technical personnel. The requirement for unmanned flying armament systems for use in combat may thus have had its origin here. Equipment was sought for one-time use, consumable materiel that had only to last for one mission. Both propulsion system and airframe had to be suitable for series production, with the smallest possible outlay in work time and simple handling in operation. The short-term goal was England; the long-term goal was the Russian hinterland and the American continent -- ranges which at that time could not be covered even by the largest aircraft without intermediate landings.

The result of development was the Fi-103 by Fieseler, known by the abbreviation V-1, which was launched from a launch ramp and was propelled in the air by a pulse-jet engine. It was preprogrammed by giving it calculated quantities of fuel. In the air, it bore a gyroscope platform. Aiming and scoring hits was out of the question; rather, it was pointed toward a large area, over which it went into a dive. On the other hand, the US surface-to-surface missiles Matador, Mace, Goose, Regulus and Snark which developed out of this beginning and which represent only a portion of the available arsenal, are so well developed in range, accuracy, reliability and destructive action that goals which would still have seemed utopian [sic] in 1945 are now a reality. The V-1 was not a wonder weapon, but a first, incomplete test of offensive unmanned flying craft designed to be used once. Combat requirements have given industry only relatively small production contracts, but these have devoured huge sums for research and development.

C. Unmanned Flying Craft

The business for series production existed where the product was actually used, even without war. A true demand was found here in the area of training. Unmanned flying craft are needed for training on armament systems designed to be used against manned aircraft. Their mission is to replace real targets. The flight behavior of the real targets must be simulated as faithfully as

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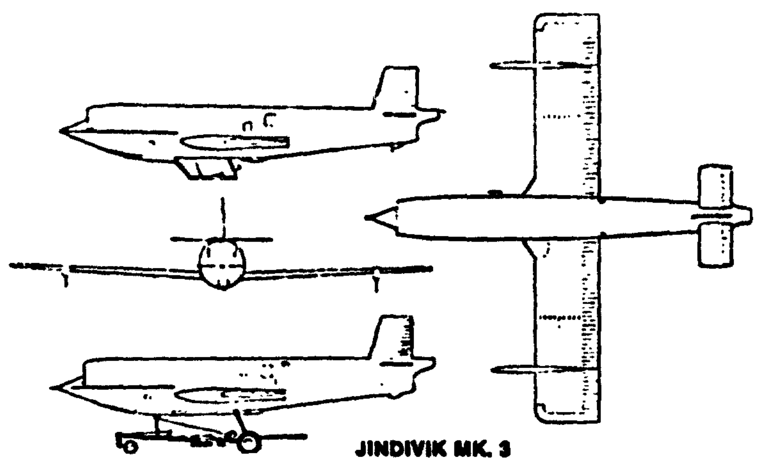

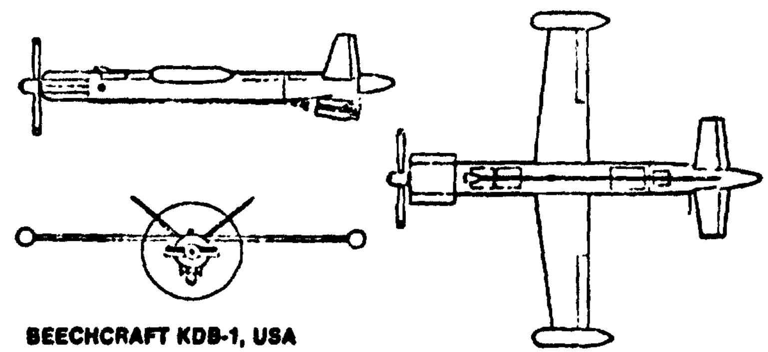

Australian Jindivik Mk.3 (left): low wing, turbine propulsion, rectangular surface, CTOL with takeoff carriage, skid landing, radio guidance.
Beechcraft KDB-1 (above): high wing, propeller-driven, rectangular surface, V control surfaces, launch ramp/ /rockets, parachute landing, radio guidance.

Different designs for unmanned flying craft after 1945.

[Figure continued on following two pages]

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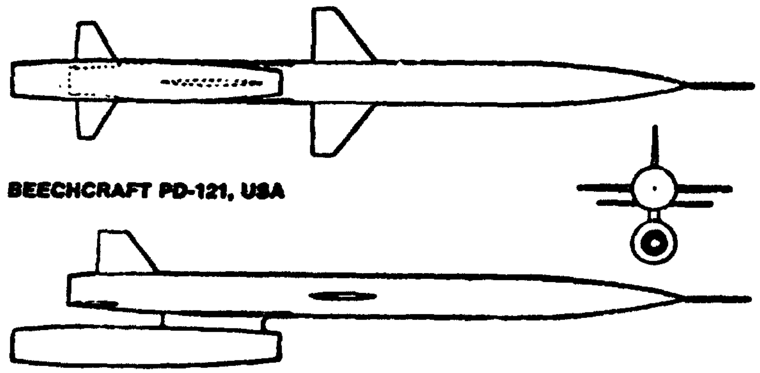
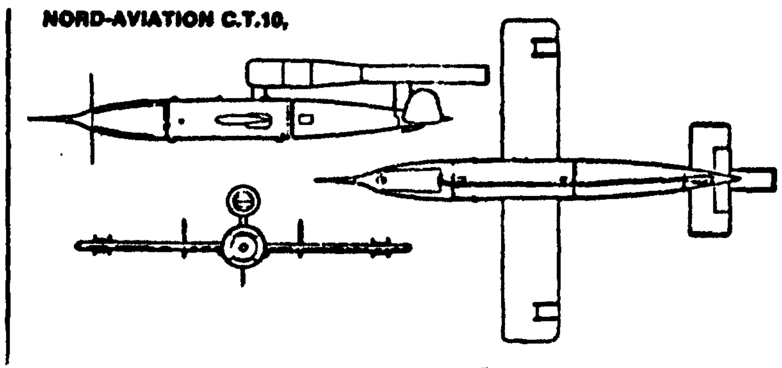


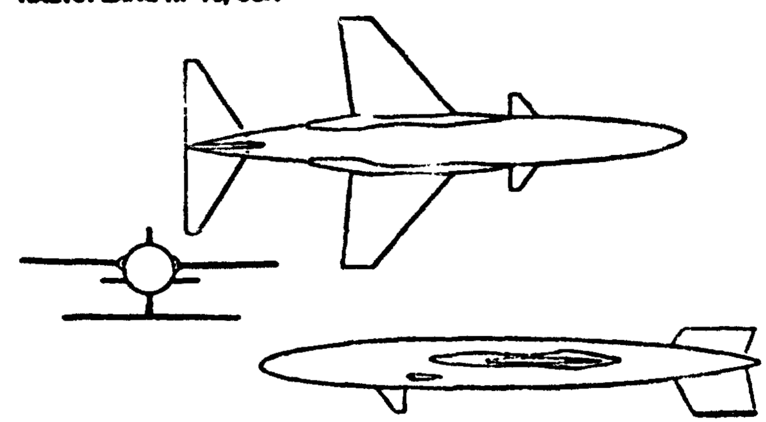
Beechcraft PD-121: midwing configuration, ram-jet propulsion, delta wings, rudder and elevators, launch ramp, parachute landing, programmed and celestial navigation.

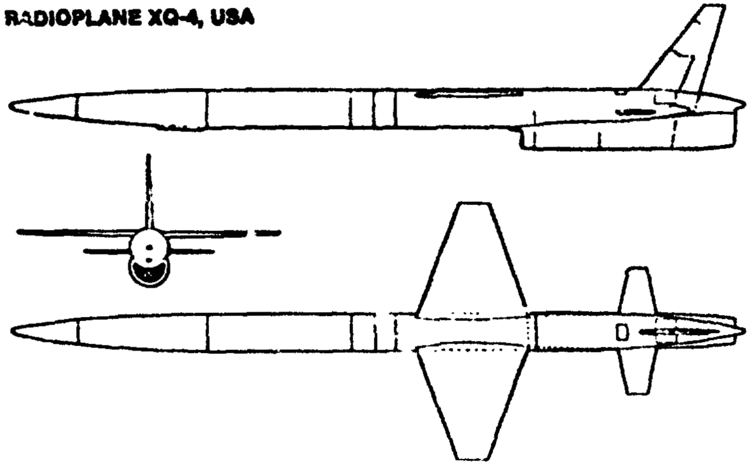


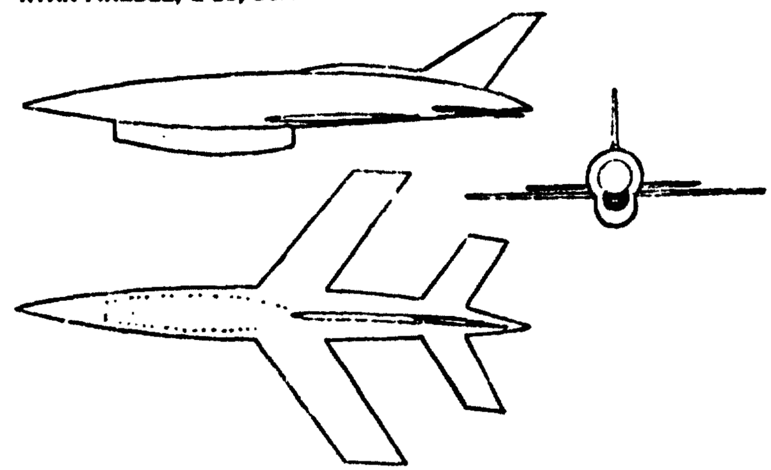
Nord-Aviation C.T.10 (French modification of V-1): midwing configuration, pulse-jet, rectangular surface, double lateral control surfaces, launch ramp, parachute landing, radio guidance.

Different designs for unmanned flying craft after 1945 [continued].

[Figure continued on following page.]







RP-76 Radioplane (upper left): midwing configuration, dual rocket propulsion, swept wings, rigid control surfaces, rudder at nose, aircraft-type takeoff, parachute landing, flight control system, radio guidance.

XQ-4 Radioplane (lower left): high wing, turbine propulsion, trapezoidal surfaces, rudder and elevators, launch ramp and aircraft-type takeoff, parachute landing, flight control system, computer, radar simulation, encoded radio guidance.

Ryan Q-2C Firebee (above): low wing, turbine propulsion, wings swept 40°, rudder and elevators, aircraft-type takeoff, parachute landing, flight control system, encoded radio guidance.

Different designs for unmanned flying craft after 1945 [concluded].

possible for this. This in turn brought with it requirements for speeds, altitudes and maneuverability, and demanded the simulation of radar reflection area and radiation of infrared energy. Thus anything which can turn up as a combat aircraft is reflected in the form of an unmanned flying craft in the arsenal of target simulation equipment. This begins again with the further development of the V-1, which by itself did not satisfy the various requirements. Everything used for aircraft propulsion, such as the propeller, turbine, ram-jet engine and rocket, is represented, as are all wing shapes and configurations -- even the landing gear and landing procedures have been copied. The Australian Jindivik Mk.3 is presently being used to test the possibility of landing on a cushion of air, since all previous landing and/or recovery methods have been too uncertain and the danger of damage to the airframe, power plant and airborne sensors has been too great. A parachute landing in a predetermined target area is the most common landing method, /35
but is still not satisfactory. Catching the drone as it descends by parachute is again too costly. The air-cushion landing method promises better results. The launch problem is not so difficult to solve. A launch ramp is enough for most systems. Launch from a flying aircraft by disengagement is used if the power plant requires dynamic pressure or other considerations make release from an aircraft appear advantageous. Thus the target aircraft are used to serve tube, rocket and aircraft armament systems, in order to train the operating personnel. Equipped with suitable transmitters, they are employed directly for electronic warfare (ECM and ECCM), for jamming and deception. We find, moreover, that the invention of remotely controlled weapons did not first occur in the 1970's nor was it started by Viet Nam. As early as 1915, German engineers tested out torpedo-gliders from airships; these were sailplanes that could be remotely controlled at up to 8 km by wire, and produced rudder movements via relays, as determined visually, using the control lever in the airship. The disengaged glider was guided toward the target by the line-of-sight method, the torpedo was released at low altitude, and the airship

was kept outside the range of the antiaircraft activity that existed at that time. Remotely controlled weapons were once more developed and tested in World War II, since aircraft losses during attack on objectives with strong AA defenses had become too high and thus intolerable. The firm of Henschel specialized here in remotely controlled weapons with wire guidance (Hs 295), radio guidance and even television guidance (Hs 293 D), while special torpedoes (Hs 294) that were supposed to allow a release range of up to 10 km were being tested for engaging ships. Here, too, development was continued. Three examples from the US show that the ranges have been increased, guidance made more accurate and not only rockets but also ram-jet engines have been put into use, but the principle has remained the same -- increase survival capability by keeping a distance. What was begun as early as 1915 was again borne out in Viet Nam: Guidable weapons can be used to destroy the required targets with accuracy from a safe distance at low cost without wreaking unnecessary destruction, such as is the case when masses of bombs are released and bombers are employed.

From a triviality we can determine where the greatest demand for weapons existed for the Germans in World War II: in antiaircraft activity. If we compare the number of projects, we find that a total of nine antiaircraft projects were in development, as opposed to six offensive projects, out of all of which only the V-1, in the form of an unmanned flying craft, and the V-2, in the form of a rocket, reached the production stage.

Surface-To-Air Antiaircraft Flying Craft

The unmanned antiaircraft flying craft included the Feuerlilie [Tiger Lily], Schmetterling [Butterfly], Feuerlilie 55 and Enzian [Gentian] projects. These are aerodynamically controllable flying craft with rocket engines for liquid fuels or solid-fuel rocket propulsion. In comparison to the armament systems developed further from these in France, England, and the US, we find that what

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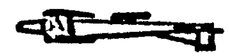
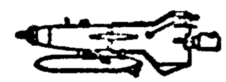
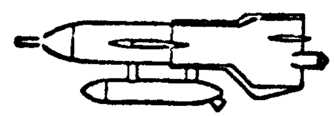
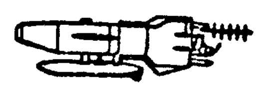
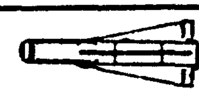
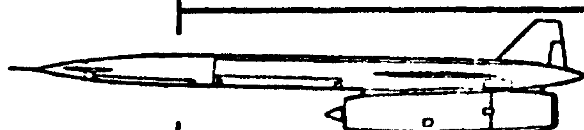
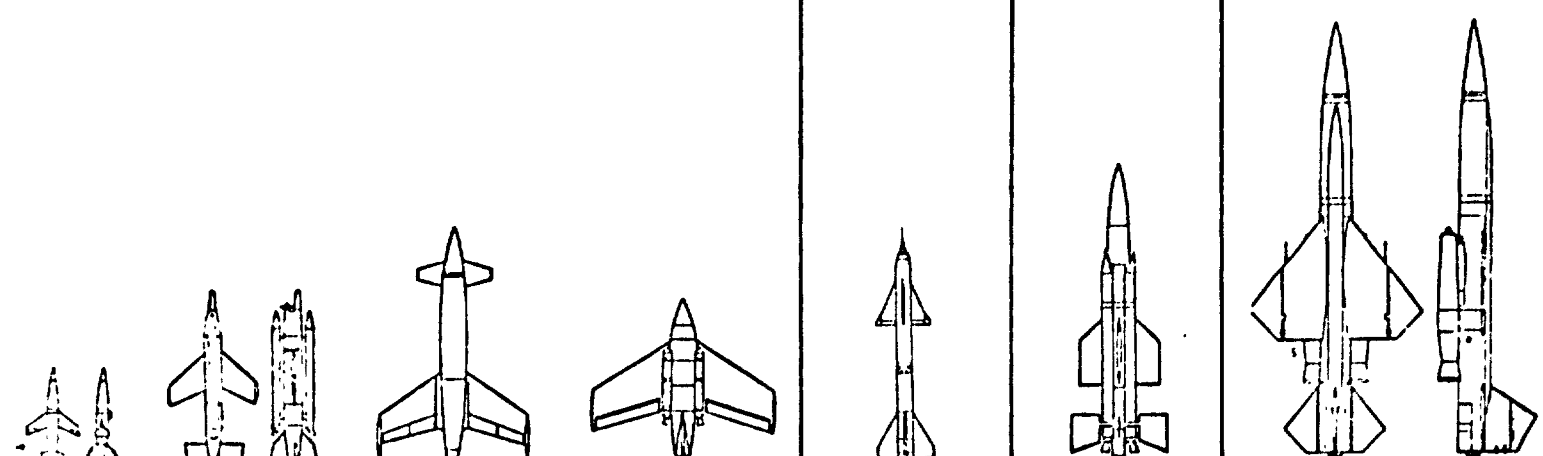
a Entwicklungsjahr	b Querschnittzeichnung	c Bezeichnung	d Reichweite	e Geschw.km/h	f Steuerung
1915-18		[i] Torpedo-Gleiter	3-8 km	-	[j] Draht
1939-45		Henschel 293	8 km	73o	Draht
in		Hs 294	1o km	9oo	k Elektron.
Deutschland [g]		Hs 295	15 km	9oo	Draht[j]/Elektr.[k]
		Hs 293 D	8 km	73o	TV/Elektr.
nach [h] 1945		Bullpup	11 km	1 7oo	Elektron.
in US		Maverick	5o km	-	TV/Elek.Eigen.[l]
		Hound Dog	8oo km	1 - 2 2oo	Kreisel[m]/Astro Navig.

Air-to-surface flying craft with bursting charges (offensive remotely controlled weapons).

Key; a. Year of development; b. Transverse view; c. Designation; d. Range; e. Speed; f. Control; g. Germany; h. After 1945; i. Torpedo glider; j. Wire; k. Electronic; l. Self-guidance, m. Gyro/celestial

Vor 1945 in Entwicklung / Erprobung in Deutschland a					Nach 1945 b entwickelt, erprobt und einsatzbereit in: Frankreich c	England	USA



Feuerlilie	Schmetterling	Feuerlilie 55	Enzian	d	SE 4400	Thunderbird	Bomarc IM 99 A
120	500	600	2 000	Startgew.kg	1 200	1 800	6 800
720	900	1 600	900	Geschw.km/h	4 300	2 500+	3 600
-	15 000	5-30 000 e (f)	12 000	Flughöhe m	geh. l	geh. l	geh. l
R/fest e	R/flüssig f	R/fest(flüss.)	R/flüss. f	Triebwerk	Staustrahl g	R/fest e	g Staustrahl
Kreiselg. h	Elektron.	Elektron.	Elektron.	Lenkung	Elektron.+ i	Elektron.+	Elektron.+
					h/a Suchk. j	h/a Suchk.	akt.Suchk. k

Surface-to-air antiaircraft flying craft (defensive antiaircraft armament systems).

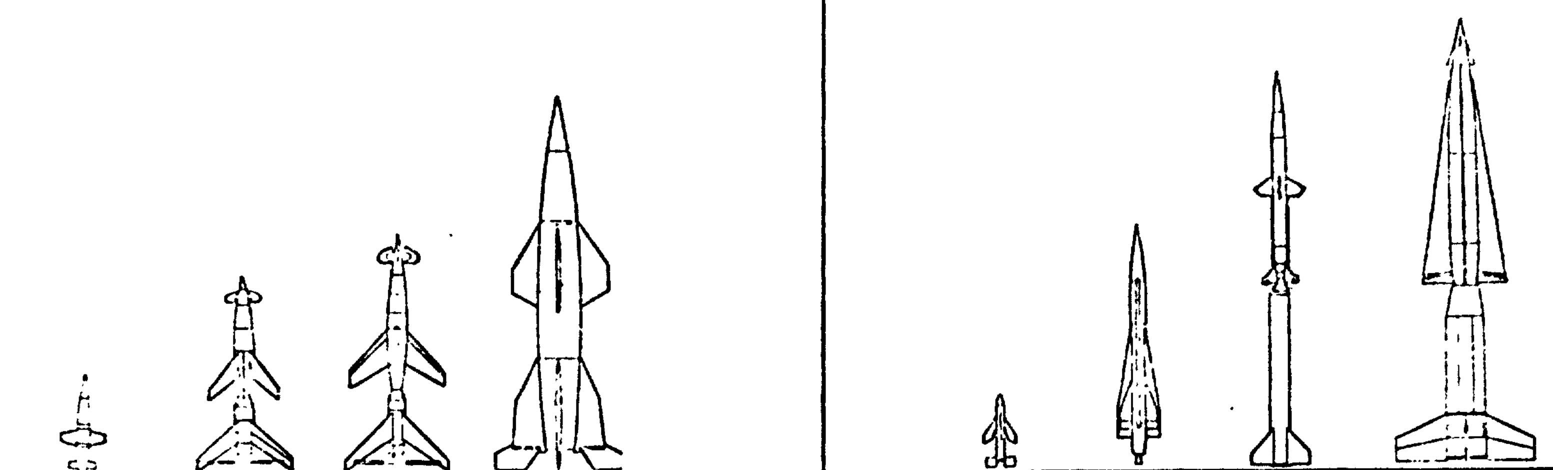
Key: a. In development/testing in Germany prior to 1945; b. Developed, tested and operational after 1945 in; c. France; d. Launch weight, speed, altitude, propulsion, guidance; e. Solid; f. Liquid; g. Ramjet; h. Gyroscopic; i. Electronic; j. h/a [expansion unknown] search unit; k. Active search unit; l. Classified might have been evaluated at that time as a "wonder" would by now have become modest starts on the scale of parameters for launch weights, speeds, altitudes and ranges. The principle of interception with unmanned flying craft was laid out here, at this early date, and is now operational in Bomarc, for example. The manned version of the rocket intercepter was the Me-163. Until now it has found no successors except the Bell X-1 and North American X-15 test aircraft, the latter of which holds all speed and altitude records.

Surface-To-Air Antiaircraft Rockets

While the unmanned rocket aircraft were further developments of the manned Me-163, completely new ground was covered in the development of antiaircraft rockets. The rocket serving as a propulsion unit was likewise tested out by German fliers, Espenlaub and Opel, in individual trials long before the Me-163. As aircraft armament, it showed up for the first time in World War I, used for biplanes which were employed to engage captive balloons. The burning time of these rockets, which were mounted on a rod and are comparable to present-day fireworks, was short. Thus effective range was kept small. If a rocket hit the gas balloon, however, the latter burned like an explosion, and the observers tried to rescue themselves with parachutes.

The Hecht [Pike], Rheintochter [Rhine Maiden] R1 and R2, and Wasserfall [Waterfall] antiaircraft rockets, on the other hand, were technically unfamiliar ground. The performance which Wasserfall achieved, for example, with a launch weight of 1650 kg, a speed of up to 2900 km/h and an altitude of up to 25,000 m (= 75,000 feet!) is a level which is still considered good at this /36
time and is not far behind that of the Seacat, Hawk, Terrier 1 and Nike Hercules rockets presently used in NATO. These four projects have been exceeded many times over in number, in hit probability and

Vor 1945 in Entwicklung/Erprobung in Deutschland [a]					Nach 1945 entwickelt, erprobt und einsatzbereit in den USA [b]			



Hecht	R1 Rheintöchter	R2	Wasserfall	[c]	Seacat	Hawk	Terrier I	Nike Hercules
14o	1 8oo	1 7oo	1 65o	Startgewicht Kg	geh. [i]	575	1 35o	4 5oo
-	1 37o	1 44o	2-2 9oo	Geschwindigkeit km/h	geh.	3 6oo	2 9oo	3 95o
-	8 ooo	12 ooo	25 ooo	Flughöhe m	geh.	3oo-12ooo	geh. [i]	3o-5o ooo
R/fest [d]	R/fest [d]	R/flüssig [e]	R/flüssig [e]	Triebwerk	R/fest [d]	R/fest	2R/fest	2R/fest
Kreisel [f]	Elektron. [g]	Elektron.	Elektron.	Lenkung	Elektr. [g]	Elektr. [g] h/a Such. [h]	Elektron. [g]	Elektron.

Surface-to-air antiaircraft rockets (defensive antiaircraft armament systems).

Key: a. In development/testing in Germany prior to 1945; b. Developed, tested and operational in the US after 1945; c. Launch weight, speed, altitude, propulsion, guidance; d. Solid; e. Liquid; f. Gyro; g. Electronic; h. h/a search unit; i. Classified reliability, however. Such performance, evaluated in purely technical terms, is overshadowed only by those contemporary developments which we could call the "German space program" of the years 1935-1945.

<u>The Uncompleted German Space Program, 1935-1945</u>

It is senseless to attempt to present evidence for the above proposition. Such evidence does not exist. This proposition results, however, from the planned rocket projects which the table shows. The A-4 rocket developed at Peenemünde is the foundation-stone for both the Russian and American moon rockets. Having begun with a launch weight of 12.9 t, the advanced version of the A-4 was supposed to be 23 t, and the A-9/A-10 was supposed to lift a total weight of 100 t.

It consisted of two rockets, one within the others, and was thus the first two-stage rocket, designed to carry a payload more than 5000 km with a maximum velocity of 12,000 km/h.

At this point, instead of seeking to increase performance by means of a three-stage rocket, planning included a project which was more advanced than the moon program: the Sänger long-range rocket transport aircraft. In this case, progress is designed to benefit the one who finances the project -- to benefit the taxpayer. A long-range transport aircraft, with a range described as 12,000-22,000 km, would have linked the continents. Even today, when such links now exist, it should be tested whether this could be done faster, cheaper and just as safely with such means of transportation.

The question arises here as to whether technical progress that serves only to increase scientific knowledge, such a landing on the Moon, is not achieved at too great an expense if the taxpayer obtains relatively little from it in the form of a usable

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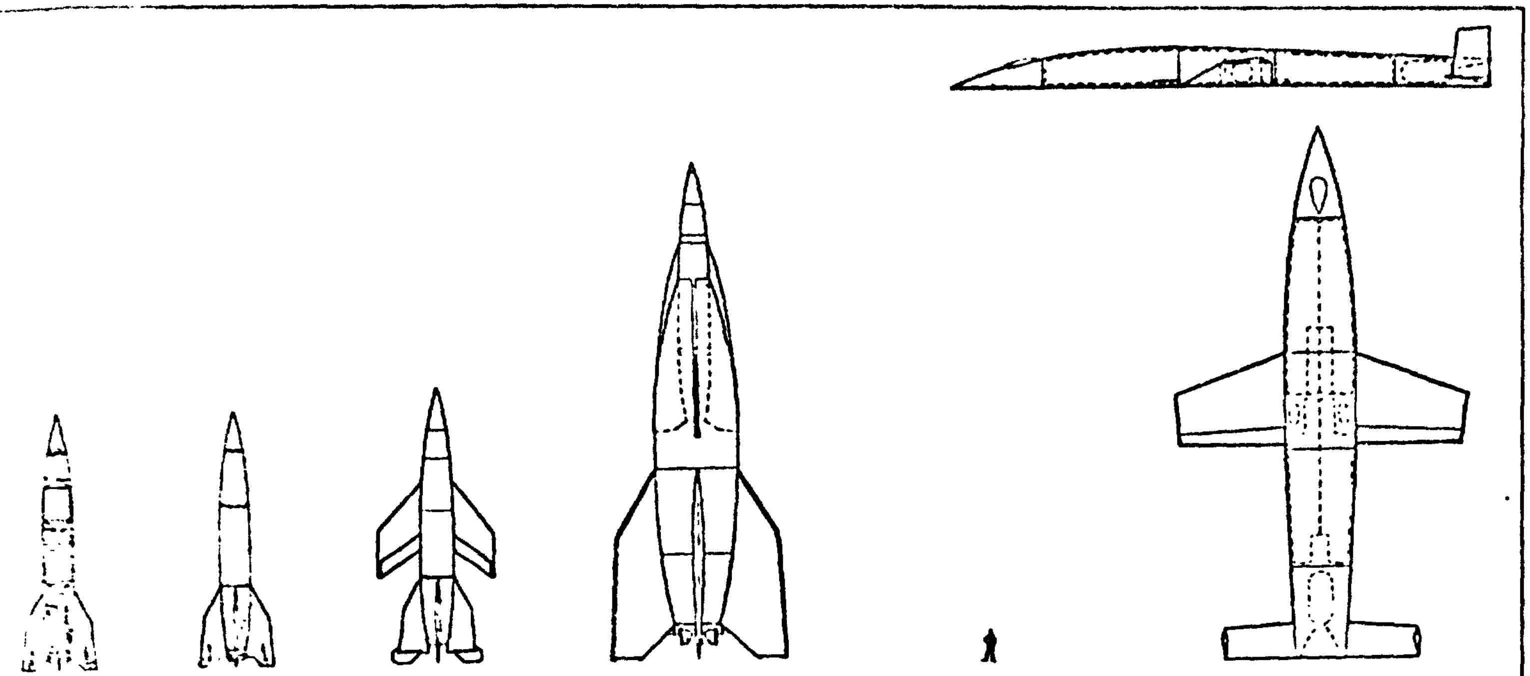

A-4	A-4 Weiter-Entwicklung[a]	A-4b (m.Flügeln)[b]	A-9/A-1o	Mensch[c]	Sänger-Raketen-Ferntransporter[d]
12,9 t 6ooo km/h 33o km	23 t 9ooo km/h 75o km	13 t 6ooo km/h 75o km	1oo t 12ooo km/h 5ooo km	[e] Startgewicht Geschwindigkeit Reichweite	1oo t 12-22 ooo km/h 5-2o ooo km

The uncompleted German space program, 1935-1945.

Key: a. Advanced version; b. (with wings); c. Man; d. Sänger long-range rocket transport aircraft; e. Launch/takeoff weight, speed, range product. For the power-politics goals of such development that are primarily sought cannot be classified in the rubric of desirable progress anyway on the basis of the considerations covered in our introductory paragraphs. Without a round of powder, they destroy the basis of prosperity: the value of the printed instrument of payment -- money. It seems more reasonable to promote those projects whose productiveness involves the needs of our fellow man. Trips to other continents are included among these; walks on the Moon will only find their way into the vacation brochures of tourist organizations at a much later date. The US's successor program already serves comparable goals: the acquisition of data which are meant to make life more worth living on Earth. The fact that we can also aim at any point on Earth from such space stations with the aid of laser aiming beams in order to accurately deliver destructive charges at the target shows here, too, that nothing, in principle, has changed. For out of the uncompleted German space program, the existence of which is only theory, the War brought none other than a terrible carrier platform which could not then, and still cannot, be intercepted at short ranges. Only the lack of nuclear charges prevented the death of additional millions when only conventional explosives were available. This "advance" did occur in 1945, however, and terminated the war in the Pacific theater. The first and only atomic bombs were dropped on Hiroshima and Nagasaki. They demonstrate "progress" and change.

Unmanned VTOL Platforms for Military Purposes

The above survey of the state of the art, the development of and advances in which would be incomplete if the unmanned flying craft presently undergoing development, representing the most advanced state of the art, were not mentioned: VTOL platforms. Landing remains a problem for unmanned flying craft that are to be reused, i.e., the operation of coming to rest on the surface of the Earth, on a landing strip or on the water. Only when it proves possible to make landing movement so slow that touchdown is achieved without endangering the unmanned flying craft does its reuse become a question of maintenance. Approach speed here is about 1 m/sec. Such low speeds during landing on extremely small areas can be achieved only by means of VTOL carrier platforms, which in turn can make use of all VTOL concepts for manned aircraft or helicopters. The Sky Spy produced by Short of Great Britain is an unmanned airscrew with a diameter of a little more than 1 m. Hovering at an altitude of 3000 m above the ground, this flying craft is not visible to jet aircraft pilots, c ot be made out with radar and IR sensors, and is thus practi invulnerable. As a reconnaissance system, it would be capabl continuous observation for as long as its fuel allowed. This equipment is presently being developed, and the developmental risk cannot yet be estimated.

On the other hand, the Aerodyne, produced by Dornier System (see Flug Revue 7/73), designed as a ducted-fan aircraft with a pivoting thrust system based on Prof. Dr. Lippisch's concept, is already undergoing flight testing. The first hover test was successful. Forward travel, the transition phase, vertical climb and landing are included in the test program. Landing takes place on stilts that are retracted during horizontal flight. Cruising speed is in the high subsonic range. As a reconnaissance system, this design possesses demonstrable advantages for its users in the Army or Navy. As a combat armament system this design can be operated from ships, since the targets to be attacked here represent objects of higher value than the Aerodyne itself. Several hundred Gyrodynes, produced by the Gyrodyne Co., USA, are presently operational in the US Navy for engaging submarines. Contrarotating helicopter rotors carry the engine, control and remote-control systems, fuels and lubricants, and two torpedoes through the air to the target area, where the torpedoes are launched and dropped into the water so they can home on the target. Here, too, it is the

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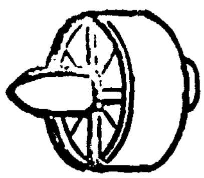
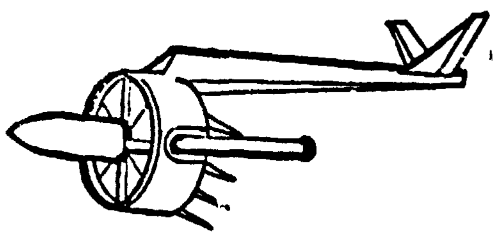
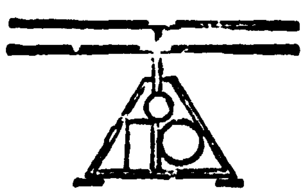


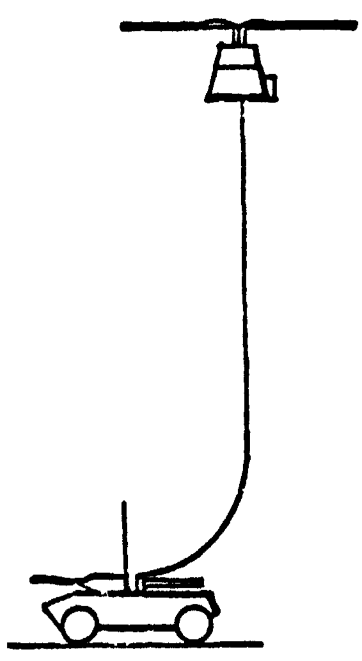
Sky Spy, produced by Short of Great Britain, VTOL and hoverable, stable annular platform, small radar reflecting and IR area, low noise level, controllable over location, reconnaissance sensors (development stage).



Aerodyne, produced by Dornier System, FRG [Federal Republic of Germany], VTOL and hoverable ducted-fan aircraft utilizing Dr. Lippisch's ADAM principle, high subsonic speed, medium range. Possible equipment: reconnaissance sensors, tube and released weapons, torpedoes (in testing).



Gyrodyne, produced by Gyrodyne Co., USA, VTOL and hoverable combat drone with contrarotating helicopter rotors, for engaging submarines from a ship. Speed 148 km/h, radius of action 87 km, flight time 1 hour 43 min, two Mk 46 torpedoes (operational).



Kiebitz [kibitzer], produced by Dornier GmbH, FRG, VTOL and hoverable captive rotor platform with reaction-propelled rotor blades, attitude stabilitzation, automatic and/or manual control, power and fuel supply through coaxial cable from surface. Possible missions:

- Border observation and battlefield reconnaissance with all reconnaissance sensors (optics, radar, IR);
- Radio relay station, directional radio station (mobile);
- ECM and radar or jamming station (ECCM);
- Remote control for remotely guided weapons (artillery and rockets).

(Being tested with individual sensors.)

Unmanned VTOL platforms for military purposes.

problem of landing the carrier platform which results in losses without enemy action. On the other hand, the "Kiebitz" carrier system, produced by Dornier GmbH, the sister organization to Dornier System, is a reaction-propelled rotor platform developed /37 from the Do-32 manned ultralight helicopter. Here, an engine produces compressed air which is forced through the rotor blades, which it leaves via nozzles that are oriented 90° relative to the direction of rotation. This prevents a reaction against the flying craft, which, stabilized with respect to attitude, can hold optical, electronic or radio-type reconnaissance sensors. The flying craft is kept above location and supplied with power and fuel via coaxial cables. The Kiebitz can be kept at a predetermined altitude for an indefinite period. The reconnaissance data obtained are transmitted directly to its base by wire, cannot be jammed, and are immediately available to the user for evaluation, without additional transmission. The ground station is mobile, the system, air-transportable. We shall terminate the list of designs for unmanned flying craft with these brief descriptions and shall consider them to have completed the survey which is needed to evaluate whether RPVs are a necessity, wishful thinking or a plaything inthe military sector.

Necessity, Wishful Thinking or Plaything?

Are unmanned flying craft necessary to defend Western Europe and the Federal Republic; if so, for what missions? They are necessary if a military goal which must be achieved, e.g. defense against a mass attack with tanks in the lowlands of North Germany directed toward the Atlantic ports, cannot be stopped by other means -- aside from nuclear weapons. The use of nuclear weapons, even for purely defensive purposes, would result in the destruction of all armed forces within a very brief time, as well as all humans within the area in which they are employed. Suicide cannot be the goal of defense, though, even if defense is supposed to be the only conceivable form of warfare for the West. If it does not prove possible to make the risk incalculable for an aggressor even in the conventional sector, then the only remaining alternative is between nuclear suicide and total subjugation to the regime of the aggressor. The possibility of making conventional warfare just as incalculable as the nuclear risk is determined by technical progress, which in turn is established by the unmanned flying craft which are currently in operation and undergoing development. An improvement in quality produces a reduction in quantity here; the meaning of this with respect to efforts toward the MBFR is that we make treaties for new rules that are to be observed by all. Why politicians do not venture to discuss the question of the voluntary renunciation of (military) force at all as the core problem of all of these negotiation efforts and to make it the subject of negotiation might be mentioned, but goes unanswered. That's politics. War is only a tool of politics, a tool in the hands of politicians, as the war in Viet Nam or in Israel is presently demonstrating and the shooting down of air liners whose pilots have strayed from their course shows in all its insanity. Warfare remains a reality and thus the impetus for tackling its problems.

If we study the necessity of developing unmanned flying craft, we must consider not only the friend/foe situation but also the geographic area which determines conditions for their utilization. The areas of combat between Warsaw Pact armed forces and NATO extend from the North Cape to Turkey. The FRG is the decisive middle section, i.e. the area between the Baltic outlets and the Alps. The line Malmö-Gedser-Lübeck-Braunschweig-Göttingen-Hof-Passau-Alps, with a length of 520 nautical miles (= 960 km) becomes the forward line of defense, while the depth of the FRG ranges between 120 nautical miles (= 220 km) and 220 nautical miles (= 408 km). If we reckon with the low-level speed of present-day combat aircraft at 450 knots, they require about 16 min to cover the 120 nautical miles and about half an hour for 220 nautical miles.

Tanks move at 60 km/h without enemy resistance; road connections are somewhat longer than the linear distance. The GDR [German Democratic Republic] is even smaller in space: north-south distance 215 nautical miles, east-west about 130 nautical miles, corresponding to 29 and 17 min of flight, respectively. An attack in the east-west direction would be expected to come from this area, which is separated from the territory of the CSSR by mountain ranges. This means a massing of troops prior to combat activities, a logistical buildup which could not be kept secret. The West has time to prepare for defense, that is, to move its forces into the defensive areas. The military objective which has been marked out can be calculated from the extent of concentration and deployment. A very large number of offensive divisions are necessary to reach the Channel ports without nuclear weapons, more than for defense, but fewer than necessary to occupy the FRG. But the number required for this still cannot be put in motion directly from a standstill. Preparations are needed.

A decisive factor for the defenders is continuous observation of the enemy's armed forces, since the time of attack can be determined from their behavior. For troops must first be brought into the preparation areas; a break must then be taken for the personnel before the offensive, and thus the loss of forces, can begin.

Permanent observation is possible only with reconnaissance systems which can observe without time limitations. Flying armament systems, both manned and unmanned, are limited in terms of time by the quantity of fuel carried -- with the exception of the Kiebitz system, which is continually supplied with power and fuel from the surface while it is in use. If we consider the present-day reconnaissance systems, this delimits early detection by high-flying systems in time intervals which allow movement to be followed from the eastern border of the GDR on into the range of systems which permanently monitor at short range. A picture of the situation is obtained which gives information without gaps concerning the troops involved in the enemy's assembly and preparation areas. Since all reconnaissance can take place from friendly territory, no danger of provocation exists. Reconnaissance consists of acquisition, recognition, identification. It can also be achieved at present without spatial or temporal gaps for army combat troops. Special reconnaissance within smaller areas can be carried out more effectively with unmanned flying craft than with /38 manned aircraft, since their ability to survive in the face of the defensive weapons of enemy ground troops is many times greater. Their radar reflecting area is smaller, their IR radiation is less, the noise level is lower, yet speed and data acquisition are approximately equivalent. If we also add the requirement for VTOL capability, then

-- survival capability on the ground increases,

-- reusability becomes a maintenance problem,

-- the time delays for data transmission between branches of the armed forces are reduced or eliminated,

and thus the combat strength of the troops defending the territory is decisively improved, since they can use their armament systems more effectively for defense. The only VTOL reconnaissance system presently in development is the Aerodyne, which satisfies the requirements that apply to Central Europe.

Unmanned flying craft to be kept in permanent reconnaissance operations, such as the Kiebitz reconnaissance system, appear to be just as necessary for supplying friendly defensive troops on the ground with reconnaissance data as are weapons systems with VTOL capabilities which possess

-- greater survival capability,

-- continuous availability,

-- independence of terrain, and

-- direct, immediate data transmission

over the battlefield and on the ground, such as are the goals of the Aerodyne.

There is also a real need for unmanned flying craft to take on missions involving the destruction of point and area targets which are too heavily defended. In contrast to the view, published in the press, that a solution to the problem is only now being offered by RPVs, the reader should consider the huge number of weapons systems which are already operational and are used just once to execute combat and destructive missions. The use of unmanned flying craft for multiple operations is the alternative solution for operations involving excessive risk of losses. Here, however, we must consider the combat conditions of short ranges and thus short flight times for manned fighter craft, and the effectiveness of automatic interception weapons of the individual combatants on the ground. The destruction of an unmanned flying craft does not require 30 mm shells; rifle or 12.7 mm machine gun bullets are sufficient. If the pilot in an aircraft can hardly assess the danger from the ground, then the remote pilot is even less capable of this, since his reaction to danger is based on a few sensor data. RPVs in low-level flight are comparable to clay pigeons, which are not difficult for the trained rifleman to shoot down.

The use of conventional weapons from high, safe altitudes becomes unfeasible because of the low accuracy. The conclusion would be that the multiple use of unmanned flying craft for operations against ground troops has little promise for success, since the probability of survival for low-flying RPVs is comparable to that of clay pigeons. Adequate weapons systems are available for one-way missions, on the other hand, or would have to be put into production again as an advanced version of the V-1. The desire to mass produce these will remain wishful thinking on the part of industry. A true demand would also be conceivable in that area where it has not yet been declared feasible: in the transportation sector.

The supplying of encircled troops on the ground can be prevented just as effectively as that with manned, large-area supply aircraft. On the other hand, transport RPVs are capable of delivering the essentials in smaller quantities, such as medical supplies, weapons and provisions in spite of air and ground defensive action and of permitting the encircled personnel to break free or to survive. Such transport systems could likewise be used in the civilian sector for catastrophes, and would be the test carriers for unmanned cargo systems in the civilian sector.

The use of unmanned flying craft would become a plaything if we attempt to employ them as fighter aircraft. Due to the lack of battlefield space in Central Europe, it would be impossible to pilot air-to-air RPVs from accompanying aircraft, since the latter would fall victim to enemy fighter defense activities, even in the farthest corner of the FRG. If the possibility of remote control from the ground existed, then we would have to expect the enemy to make use of the same systems. As long as the fighter RPV flies outside the range of the clay-pigeon shooters on the ground, it cannot itself be a danger to them. Since it can hardly recognize them as a threat in time, it always remains inferior to them and is thus forced to remain at high altitude. A weapons system without weapons effects is a plaything, no matter how much fun it is to use -- unless the politicians could agree to only allow warfare to be carried out with unmanned flying craft in the future; then technical progress alone would be decisive. As long as humans participate in warfare as components of the armament systems, however, they represent the superior building block of the system for engineering, since we are not capable of technically producing the human brain at the same cost.

In summary, we can thus state that in order to carry out successful defensive operations with conventional weapons in the military sector, unmanned flying craft

-- are a necessity in reconnaissance, just as they are in electronic warfare (ECM/ECCM)

-- are becoming a necessity in the one-time utilization of weapons and

-- may become desirable for transport purposes -- something which concerns the equipping of combat troops.

The selection of optimal technical concepts must meet the goals which are established and striven for in political terms. It should satisfy the military situational evaluation. Weapons systems without weapons effects remain a plaything, however, though a very interesting one in technical terms.